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DESCRIPTION OF *MEMBRANOBALANUS ROBINAE*, A NEW SPECIES OF SPONGE BARNACLE (CIRRIPEDIA, ARCHEOBALANIDAE) FROM BAJA CALIFORNIA, WITH A KEY TO THE GENUS

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Abstract.—The California Academy of Sciences, Department of Invertebrate Zoology and Geology has recently undertaken a joint research program with the Centro de Investigaciones de Ciencia y de Educacion Superior de Ensenada (CICESE). The present paper documents a new species of the sponge barnacle *Membranobalanus* Pilsbry from Bahía de los Angeles collected during two expeditions in 1984. A key to the genus *Membranobalanus* is included.

Systematic Account

Subclass Cirripedia Burmeister, 1834
Order Thoracica Darwin, 1854
Suborder Balanomorpha Pilsbry, 1916
Superfamily Balanoidea (Leach) Newman & Ross, 1976
Family Archaeobalanidae Newman & Ross, 1976
Subfamily Archaeobalaninae Newman & Ross, 1976
Genus *Membranobalanus* Pilsbry, 1916
Membranobalanus robinae, new species

Holotype.—Complete shell, opercular plates and body preserved in 75% EtOH, California Academy of Sciences (CAS), San Francisco, 061082.

Dimensions of holotype.—Height 4.6 mm; carinorostral diameter 4.0 mm; lateral diameter 3.7 mm.

Type locality.—Station BLA-11, 28°54′N, 113°30′W, Mexico, Baja California, Gulf of California, Bahía de los Angeles, ½ mile south of Casa Diaz, depth 10 feet, 6 Oct 1984.

Material examined.—CAS paratypes 061083, 061084, 061086, one specimen each, and CAS 056184, about 100 specimens, Mexico, Baja California, Gulf of California, Bahía de los Angeles, Punta Gringa, depth 10–15 feet. CAS paratype 061085, Mexico, Baja California, Gulf of California, Bahía de los Angeles, ½ mile south of Casa Diaz, depth 0–10 feet.

Paratype distribution.—Paratypes have been deposited at the National Museum of Natural History (USNM 211487), Scripps Institution of Oceanography (SIO C9559), the Santa Barbara Museum of Natural History (SBMNH 35076), the Los Angeles County Museum of Natural History (LACM 84-203.1), as well as the California Academy of Sciences (as listed above).

Diagnosis.—Shell thin, white, radii present, widening near orifice; orifice oval, summits of wall plates nearly level, not deeply toothed; rostrum same length as other compartmental plates or only slightly longer; base of wall plates rounded giving base a lobed appearance; opercular plates without chitinous lamellae; scutal adductor ridge incipient or lacking; tergal spur broad, extending about ⅔ of basal margin, and short, only about ⅕ of basal margin width; tergal articular ridge gently sloped to sharp crest, bending ½ way between apex and basal margin toward and descending to scutal margin then rising along margin to high point near basal margin; outer ramus of Cirrus IV with up to 6 recurved teeth per article; basal articles of Cirrus IV with several tooth-like spines at distal posterior margin.

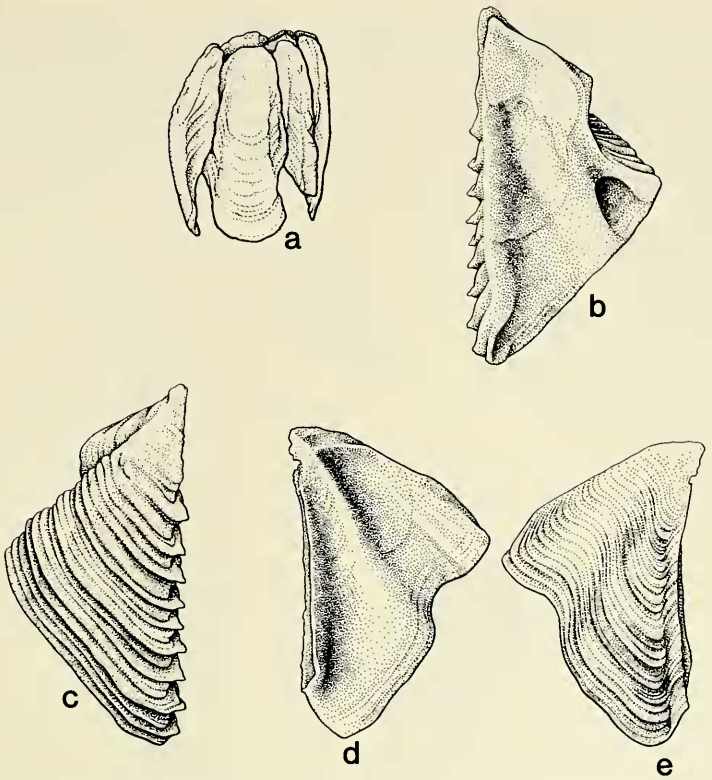

Fig. 1. *Membranobalanaus robinae*: a, Shell, holotype CAS 061082; b, Inner view of scutum, paratype CAS 061083; c, Outer view of scutum, paratype CAS 061083; d, Inner view of tergum, paratype CAS 061083; e, Outer view of tergum, paratype CAS 061083. Scale: a, ×10; b–e, ×50.

Description.—Shell (Fig. 1a) cylindrical to high-conic, white, opening oval with summits of plates even and flattened by wear; compartmental plates solid but very thin and fragile, easily disarticulated or broken; parietes with fine longitudinal striae perpendicular to growth lines; rostrum slightly longer than or equal to length of carina and laterals. Carinolaterals shorter and narrower than other plates; carina, rostrum and laterals very similar in length and width, all 4 with curved triangular shape on upper half with narrower semioval lower half. Carina very deeply curved laterally in comparison to other plates. Radii very broad, wider than paries of carinolaterals; alae broad, extending about ⅔ length of plates.

Scutum (Fig. 1b–c) thick, convex, white; basal margin slightly shorter than or equal to length of tergal margin; tergal margin inflexed; exterior with prominent growth ridges every second or third forming a tooth that extends onto occludent margin. Articular ridge triangular and as high as long, extending from apex to lower third of scutum; articular furrow moderately shallow and narrow. Adductor ridge absent or inconspicuous and rounded; triangular adductor pit shallow on its broad, rounded open basal end to deep and narrow on its apical end; depressor muscle pit large and deep, oval or triangular extending up from basal margin over ¾ distance to base of articular ridge.

Tergum (Fig. 1d–e) thin, white; about same width as scutum; basal margin slightly longer than scutal margin; growth ridges finer

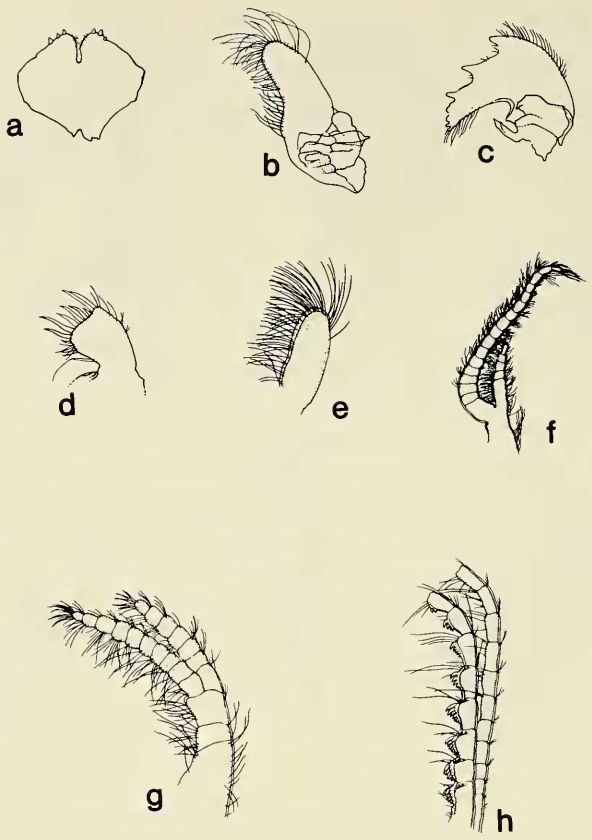

Fig. 2. *Membranobalanus robinae*: a, Labrum, paratype CAS 061084; b, Palp, paratype CAS 061084; c, Mandible, paratype CAS 061084; d, First maxilla, paratype CAS 061084; e, Second maxilla, paratype CAS 061085; f, Cirrus I, paratype CAS 061085; g, Cirrus II, paratype CAS 061085; h, Cirrus IV, paratype CAS 061085. Scale: a–e, g, ×100; f, ×50; h, ×75.

and shallower than those of scutum, spur fasciole broad and delimited only by shifts in orientation of growth lines with no abrupt changes in elevation; tergal spur ½ to ⅔ width of basal margin and about ⅓ as long as basal width of spur, basally truncate at angle to basal margin; articular ridge slightly concave, distinct, reflexed 90 degrees toward scutal margin about ½ way from apex to basal margin, height decreases from apex as ridge approaches scutal margin, then increases as ridge bends back along lower ½ of scutal margin; depressor crests may appear as 2 or 3 distinct ridges or incipient ridges without discernable depth or height, or may be absent.

Labrum (Fig. 2a) triangular, with deep notch at apex of crest; up to 3 teeth present on each side of notch.

Palp (Fig. 2b) kidney-shaped, upper margin concave, densely setose, setae slightly shorter than width of palp; tip of palp densely setose, setae pectinate and longer than those of upper margin; lower margin devoid of setae over proximal ⅔ of palp.

Mandible (Fig. 2c) with 3 large teeth and 2 smaller teeth; first tooth most robust, about same length as second tooth; second tooth not bifid, located near center of cutting edge; third tooth about ⅔ length of first and second teeth; fourth and fifth about ⅛ length of first and second teeth; inferior angle armed

with 2 small denticles or spines; inferior and superior margins setose.

Maxilla I (Fig. 2d) with straight edge; upper spine largest but equaled in length by sixth spine; second spine about ⅓ length of first spine; third, fourth, fifth and seventh spines ⅔ to ⅞ length of first spine; inferior angle with several short spines; superior margin setose; inferior margin lacking setae.

Maxilla II (Fig. 2e) ovate, superior and posterior margins densely setose, hooked setae present on posterior margin.

Cirrus I (Fig. 2f) with unequal rami; anterior ramus about 3 times length of posterior ramus; articles of both rami slightly protuberant; both rami setose; hooked setae at apex of posterior rami; setae extremely pectinate near base, giving appearance of ferns or down feathers; short spines present near distal end of articles; Cirrus II (Fig. 2g) shorter than other cirri; inner ramus about ⅔ length of outer ramus; articles of both rami slightly protuberant; covered with pectinate setae; setae more fern-like near base; short spines present near distal end of articles; Cirrus III longer than Cirrus II; setae form and distribution similar to Cirri I and II; short spines present near distal end of articles; Cirrus IV (Fig. 2h) longer than Cirrus III; outer ramus bearing large, recurved teeth on medial protuberant articles; rami of equal length and diameter; setae pectinate; spines in rows along distal margins of articles, 3–6 most posterior of these spines much larger and tooth-like than spines on other cirri; pedicel about ½ length of rami; Cirrus V longer than Cirrus IV; setae as in other cirri; small spines present along distal anterior margin as in Cirri I–III; Cirrus VI longer than Cirrus V; pectinate setae as in other cirri; small spines on anterior distal margin as in other cirri.

Etymology.—The specific name *robinae* is in honor of Robin Ring.

Discussion.—*Membranobalanus robinae* is unique among species of *Membranobalanus* in possessing basally rounded compartmental plates of approximately equal length that give a lobed appearance to the whole barnacle when viewed from the side (Fig. 1a, Holotype). The new species bears recurved teeth on the outer ramus of Cirrus IV, indicating a relationship with Western Hemisphere *Membranobalanus* (Zullo & Standing 1983). Eastern Hemisphere membranobalanids have straight teeth or spines on the outer ramus of Cirrus IV.

The other Western Hemisphere membranobalanids are *M. declivis* (Darwin, 1854) (western Atlantic south of Cape Fear, N.C.), *M. costatus* Zullo & Standing, 1983 (Cape Fear, N.C.), *M. orcutti* (Pilsbry, 1907) (southern California and Mexico), and *M. nebrias* (Zullo & Beach, 1973) (Galapagos Islands).

Based on examination of approximately 50 specimens of *M. robinae,* the new species differs from *M. orcutti, M. nebrias* and *M. declivis* in the length of the rostrum. Both *M. orcutti* and *M. declivis* have rostra which are considerably longer than their other compartmental plates. The rostrum of *M. nebrias* while not as long as the rostra of *M. orcutti* or *M. declivis,* is decidedly longer than the other compartmental plates. There was very little variation in rostrum length relative to the length of other compartmental plates in the specimens of *M. robinae* examined. *M. robinae,* like *M. costatus,* has a rostrum whose length is nearly equal to that of its other compartmental plates. However, *M. robinae* differs consistently from *M. costatus* in many respects: (1) the rami of Cirrus IV are equal rather than unequal in length and diameter; (2) radii are present and well developed; (3) the parietes lack prominent costae; (4) the occludent margin of the scutum bears several teeth formed by extensions of prominent external growth ridges; (5) the bases of the parietes are rounded giving the base of the barnacle a lobed appearance when viewed from the side.

Species in the genus *Membranobalanus* Pilsbry are obligate symbionts of sponges. Although most species have been found in

Table 1.—Species of *Membranobalanus* and the species of sponge which they are known to inhabit. Authors of references used to compile this table are listed, complete citations may be found in Literature Cited.

Barnacle species	Sponge species	Author
M. declivis	*Spheciospongia vesparum*	Pearse 1932
		Wells 1966
		Zullo & Standing 1983
M. nebrias	"Clionid"	Zullo & Beach 1973
M. koreanus	*Cliona celata*	Kim & Kim 1983
M. cuneiformis	*Cliona* sp.	Hiro 1936
		Utinomi 1968
M. longirostrum	*Spirastrella purpurea*	Rosell 1972
		Utinomi 1968
M. longirostrum	*Suberites inconstans*	Utinomi 1968
M. costatus	*Anthosigmella varians*	Zullo & Standing 1983
M. orcutti	*Spheciospongia confoederata*	Jones 1978
	Cliona celata californiana	Jones 1978
	"red clionid"	Zullo & Beach 1973
	"calcareous"	Rosell 1973
M. brachialis	"probably *Cliona* sp."	Rosell 1972
M. basicupula	*Suberites inconstans*	Sukaimi 1966
M. robinae	*Delaubenfelsia raromicrosclera*	Van Syoc herein

only one species of sponge (Table 1), *M. longirostrum* in the western Pacific and Indo-Pacific inhabits at least two species of sponges (Utinomi 1968) as does *M. orcutti* (Jones 1978) in California and Baja California.

The question of host specificity in *Membranobalanus* has been considered only with regard to *M. orcutti* (Jones 1978) and *M. costatus* (Zullo & Standing 1983).

The other genus of sponge barnacle, *Acasta* Leach, has many species which inhabit more than one host sponge species. For example, *Acasta cyathus* inhabits *Verongula ardis* (de Laubenfels, 1950), *Ircinia campana* (Lamarck, 1813), *Erylus ministrongulus* Hectel, 1965, *Ircinia felix* (Duchasaing & Michelotti, 1864), *Spinosella* (=*Callyspongia*) *vaginalis* (Lamarck, 1814), and *Spongia tubulifera* Lamarck, 1814, and at least two other species of Demospongea in North Carolina (Wells 1966; Zullo & Standing 1983).

To date, *M. robinae* has been found in only one species of sponge, *Delaubenfelsia raromicrosclera* Dickinson, 1945, at one location, Bahía de los Angeles in the Gulf of California. If *M. robinae* lives in *D. raromicrosclera* throughout a greater part of the sponge's range, we might expect to find it elsewhere in the Gulf of California (Dickinson 1945, Hofknecht 1978).

Key to the Genus *Membranobalanaus*

1a. Rostrum much longer than other compartmental plates 2
b. Rostrum nearly as long, or as long as, other compartmental plates .. 6
2a. Fourth cirrus with recurved teeth or spines on proximal articles ... 3
b. Fourth cirrus with straight teeth or spines on proximal articles 4
3a. Radii present .. *M. declivis* (Darwin)
b. Radii lacking or very narrow ... . *M. orcutti* (Pilsbry)
4a. Radii present .... *M. koreanus* Kim and Kim
b. Radii lacking or very narrow ... 5
5a. Parietes with distinct horizontal growth lines .. *M. brachialis* (Rosell)

b. Parietes without distinct horizontal growth lines .... *M. longirostrum* (Hoek)

6a. Fourth cirrus with recurved teeth 7

b. Fourth cirrus with straight teeth . ..... *M. cuneiformis* (Hiro)

7a. Base of barnacle having a lobed appearance in side view due to rounded ends of compartmental plates ..... *M. robinae,* sp. nov.

b. Base not lobed in appearance when viewed from side 8

8a. Parietes costate .... *M. costatus* Zullo and Standing

b. Parietes not costate .... *M. nebrias* (Zullo and Beach)

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